



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/634,667	08/05/2003	Katherina Babich	YOR920030174US1	7152

7590 07/26/2005

Ryan, Mason & Lewis, LLP
Suite 205
1300 Post Road
Fairfield, CT 06824

EXAMINER

WALKE, AMANDA C

ART UNIT	PAPER NUMBER
----------	--------------

1752

DATE MAILED: 07/26/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/634,667

Applicant(s)

BABICH ET AL.

Examiner

Amanda C. Walke

Art Unit

1752

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 April 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-30 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-30 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1-30 are rejected under 35 U.S.C. 102(b) as being anticipated by Lin et al (6,087,064).

Lin et al disclose novel silsesquioxane polymers are formed by methods which avoid the use of BBr₃. The novel silsesquioxane polymers are especially useful in negative photoresist compositions and photolithographic processes. Alternatively, improved silsesquioxane polymer-containing negative photoresist compositions are obtained by using a polymer component containing a blend of silsesquioxane polymer and non-silsesquioxane polymer. The photoresist compositions provide improved dissolution characteristics enabling the use of 0.26 N TMAH developer. The photoresist compositions also provide improved thermal characteristics enabling use of higher processing temperatures. The photoresist compositions are especially useful in a multilayer photolithographic processes and are capable of producing high resolution. Examples of the novel silsesquioxane polymers of the invention include: poly(p-hydroxyphenylethylsilsesquioxane) (PHPES), poly(p-hydroxyphenylethylsilsesquioxane-co-p-hydroxy-.alpha.-methylbenzylsilsesquioxane) (PHPE/HMBS), poly(p-hydroxyphenylethylsilsesquioxane-co-methoxybenzylsilsesquioxane) (PHPE/MBS), poly(p-hydroxyphenylethylsilsesquioxane-co-t-butylsilsesquioxane) (PHPE/BS), poly(p-

Art Unit: 1752

hydroxyphenylethylsilsesquioxane-co-cyclohexylsilsesquioxane) (PHPE/CHS), poly(p-hydroxyphenylethylsilsesquioxane-co-phenylsilsesquioxane) (PHPE/PS), poly(p-hydroxyphenylethylsilsesquioxane-co-bicycloheptylsilsesquioxane) (PHPE/BHS), polyp-hydroxy-.alpha.-methylbenzylsilsesquioxane) (PHMBS), polyp-hydroxy-.alpha.-methylbenzylsilsesquioxane-co-p-hydroxybenzylsilsesquioxane) (PHMB/HBS), poly(p-hydroxy-.alpha.-methylbenzylsilsesquioxane-co-methoxybenzylsilsesquioxane) (PHMB/MBS), poly(p-hydroxy-.alpha.-methylbenzylsilsesquioxane-co-t-butylsilsesquioxane) (PHMB/BS), poly(p-hydroxy-.alpha.-methylbenzylsilsesquioxane-co-cyclohexylsilsesquioxane) (PHMB/CHS), poly(p-hydroxy-.alpha.-methylbenzylsilsesquioxane-co-phenylsilsesquioxane) (PHMB/PS), poly(p-hydroxy-.alpha.-methylbenzylsilsesquioxane-co-bicycloheptylsilsesquioxane) (PHMB/BHS), and poly(p-hydroxybenzylsilsesquioxane-co-p-hydroxyphenylethylsilsesquioxane) (PHB/HPES). The crosslinking agent used in the photoresist compositions of the invention may be any suitable crosslinking agent known in the negative photoresist art which is otherwise compatible with the other selected components of the photoresist composition. The crosslinking agents preferably act to crosslink the polymer component in the presence of a generated acid. Preferred crosslinking agents are glycoluril compounds such as tetramethoxymethyl glycoluril, methylpropyltetramethoxymethyl glycoluril, and methylphenyltetramethoxymethyl glycoluril, available under the POWDERLINK trademark from American Cyanamid Company. Other possible crosslinking agents include: 2,6-bis(hydroxymethyl)-p-cresol, compounds having the following structures: ##STR6## including their analogs and derivatives, such as those found in Japanese Laid-Open Patent Application (Kokai) No. 1-293339, as well as etherified amino resins, for example methylated or butylated

Art Unit: 1752

melamine resins (N-methoxymethyl- or N-butoxymethyl-melamine respectively) or methylated/butylated glycolurils, for example as can be found in Canadian Patent No. 1 204 547. Combinations of crosslinking agents may be used.

The photosensitive acid generators used in the photoresist compositions of the invention may be any suitable photosensitive acid generator known in the negative photoresist art which is otherwise compatible with the other selected components of the photoresist composition.

Examples of preferred photosensitive acid generators (PAG) include:--

(trifluoromethylsulfonyloxy)-bicyclo[2.2.1]hept-5-ene-2,3-dicarboximide ("MDT"), onium salts, aromatic diazonium salts, sulfonium salts, diaryliodonium salts and sulfonic acid esters of N-hydroxyamides or -imides, as disclosed in U.S. Pat. No. 4,731,605. Also, a PAG that produces

The photoresist compositions may further include an organic base additives, surfactants, sensitizers or other expedients known in the art. The compositions of the invention are not limited to any specific selection of these expedients. Examples of base additives include: dimethylamino pyridine, 7-diethylamino-4-methyl coumarin ("Coumarin 1"), tertiary amines, proton sponge, berberine, and the polymeric amines as in the PLURONIC or TETRONIC series from BASF. Tetra alkyl ammonium hydroxides or cetyltrimethyl ammonium hydroxide may be used as a base additive when the PAG is an onium salt. Examples of possible surfactants include fluorine-containing surfactants such as FLUORAD FC-430 available from 3M Company in St. Paul, Minn., and siloxane-containing surfactants such as the SILWET series available from Union Carbide Corporation in Danbury, Conn. Examples of sensitizers include chrysenes, pyrenes, fluoranthenes, anthrones, benzophenones, thioxanthenes, and anthracenes, such as 9-anthracene methanol (9-AM). Additional anthracene derivative sensitizers are disclosed in U.S.

Art Unit: 1752

Pat. No. 4,371,605. The sensitizer may include oxygen or sulfur. The preferred sensitizers will be nitrogen free, because the presence of nitrogen, e.g., an amine or phenothiazine group, tends to sequester the free acid generated during the exposure process resulting in loss of photosensitivity. The photoresist compositions of the invention are not limited to any specific proportions of the various components. Where the photoresist compositions of the invention contain a solvent, the compositions preferably contain about 5 to 50 wt. % solids. The amount of PAG is preferably about 1 to 20 wt. % based on the weight of the polymer component. The amount of crosslinking agent is preferably about 1 to 30 wt. % based on the weight of the polymer component, more preferably about 5 to 25 wt. %. The photoresist compositions of the invention are especially useful as imaging layers in multilayer photolithographic processes, however, the photoresist compositions of the invention may be used in single layer photolithographic processes. Preferably, the photoresist compositions of the invention may be patterned using various radiation types such as mid-UV, deep-UV (specifically 248 nm, 193 nm, and 157 nm wavelengths), extreme-UV (approximately 13 nm wavelength), x-ray, electron beam, and ion beam. The appropriate radiation type(s) may depend on the components of the overall photoresist composition (e.g., the selection of the photosensitive acid generator, sensitizer, polymer component, etc.). The photoresist compositions of the invention generally provide high resolution (approximately 300 nm resolution or less) in combination with desired dissolution behavior. For example, resist compositions using the blended polymer component described above typically provide resolution of 200 nm or less. The PBB/MBS copolymer used to create FIGS. 2 and 3 produced 250 nm resolution when the polymer component included 40 wt. % poly(4-hydroxystyrene) and 230 nm resolution when the polymer component included 30

Art Unit: 1752

wt. % poly(4-hydroxystyrene). Similarly, PHPE/BS polymer with 2 HPES repeating units to 1 t-butylsilsesquioxane repeating unit produced 190 nm resolution when the polymer resin included 30 wt. % poly(4-hydroxystyrene).

The invention provides a multilayer lithography method including the steps of: a) forming a first layer of a planarizing material on a substrate; b) forming a second layer of a photoresist material on the first layer, wherein the second layer includes a photoresist composition of the invention; c) pattern-wise exposing the second layer to radiation using a patterning tool, followed by post-exposure baking; d) developing a pattern in the second layer to remove unexposed portions of the second layer and to form a patterned resist that reveals portions of the first layer; and e) removing revealed portions of the first layer using remaining portions of the second layer as a mask. Preferably, the resist image formed in the second layer is a high resolution resist image. Preferably, the step of developing the second layer uses a TMAH solution of about 0.14 N or greater, more preferably about 0.20 N or greater, most preferably about 0.26 N or greater.

Given the teachings of the reference, the instant claims are anticipated.

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kennedy et al (6,506,497) in view of Feder et al (6,521,699).

Kennedy et al disclose anti-reflective coating materials for deep ultraviolet photolithography include one or more organic light-absorbing compounds incorporated into spin-on-glass materials. Suitable absorbing compounds are strongly absorbing over wavelength ranges around wavelengths such as 365 nm, 248 nm, and 193 nm that may be used in photolithography. A method of making absorbing spin-on-glass materials includes combining one or more organic absorbing compounds with alkoxysilane or halosilane reactants during synthesis of the spin-on-glass materials.

An anti-reflective coating material for deep ultraviolet photolithography includes one or more organic absorbing compounds incorporated into a spin-on-glass (SOG) material. The spin-on-glass materials include methylsiloxane, methylsilsesquioxane, phenylsiloxane, phenylsilsesquioxane, methylphenylsiloxane, methylphenylsilsesquioxane, and silicate polymers. As used herein, spin-on-glass materials also include hydrogensiloxane polymers of the general formula $(H_{0-1.0} SiO_{1.5-2.0})_x$ and hydrogensilsesquioxane polymers, which have the formula $(HsiO_{1.5})_x$, where x is greater than about 8. Also included are copolymers of hydrogensilsesquioxane and alkoxyhydridosiloxane or hydroxyhydridosiloxane. Spin-on-glass materials additionally include organohydridosiloxane polymers of the general formula $(H_{0-1.0} SiO_{1.5-2.0})_n (R_{0-1.0} SiO_{1.5-2.0})_m$, and organohydridosilsesquioxane polymers of the general formula $(HsiO_{1.5})_{sub.n} (RSiO_{1.5})_{sub.m}$, where m is greater than 0 and the sum of n and m is greater than about 8 and R is alkyl or aryl. Coating solutions of spin-on-glass materials incorporating absorbing compounds are used to form anti-reflecting films on various layers in integrated circuit devices. Absorbing compounds suitable for use with the present invention are strongly absorbing at wavelengths less than about 375 nm or less than about 260 nm. In particular, suitable absorbing compounds are

Art Unit: 1752

strongly absorbing over at least an approximately 10 nm wide wavelength range around wavelengths such as 248 nm, 193 nm, or other ultraviolet wavelengths, such as 365 nm, that may be used in photolithography. The chromophores of suitable compounds typically have from one to three benzene rings that may or may not be fused. Incorporatable absorbing compounds have an accessible reactive group attached to the chromophore, the reactive groups including hydroxyl groups, amine groups, carboxylic acid groups, and substituted silyl groups with silicon bonded to one, two, or three alkoxy group or halogen atom substituents. The reactive groups may be directly bonded to the chromophore or the reactive groups may be attached to the chromophore through a hydrocarbon bridge.

Examples of suitable organic absorbing compounds include anthraflavic acid, 9-anthracene carboxylic acid, 9-anthracene methanol, alizarin, quinizarin, primuline, 2-hydroxy-4(3-triethoxysilylpropoxy)-diphenylketone, rosolic acid, triethoxysilylpropyl-1,8-naphthalimide, 9-anthracene carboxy-methyl triethoxysilane, phenyltriethoxysilane, azo compounds, such as 4-phenylazophenol, and mixtures thereof.

The reference teaches that conventional additives may be included in the layer, but fails to specifically mention a cross-linking agent.

Feder et al disclose a layer similar to that of Kennedy et al. The reference teaches that polysilsesquioxane compositions conventionally comprise cross-linking agents (see abstract).

Given the teachings of the references, it would have been obvious to one of ordinary skill in the art to prepare the material of Kennedy et al choosing to employ a cross-linking agent with reasonable expectation of achieving a material able to form a pattern having small features.

Art Unit: 1752

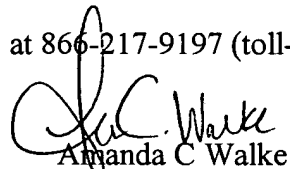
Conclusion

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Gronbeck et al (6,803,171), De et al (6,916,543), Gonsalves (2002/0182541), Johnson et al (4,221,688), Berg et al (5,674,937 and 5,994,459), Weiss et al (5,085,893), and Angelopoulos et al (6,653,045 and 6,821,718) are cited for their teachings of similar materials.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Amanda C. Walke whose telephone number is 571-272-1337. The examiner can normally be reached on M-R 5:30-4.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Cynthia Kelly can be reached on 571-272-1526. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).


Amanda C Walke
Examiner
Art Unit 1752

ACW
July 24, 2005